REMARKS

1. AMENDMENTS TO THE SPECIFICATION

The Examiner has objected to the abstract of the disclosure because of undue length. Accordingly, Applicants have been amended the abstract to reduce the length to less than 150 words, and has inserted into appropriate sections of the specification the language that was deleted from the abstract. Applicants have also attached a clean version of the amended abstract at the end of this paper. Applicants request that the Examiner withdraw the objection.

The specification also has been amended to introduce the editorial changes specifically requested by the Examiner. No new matter has been added with this amendment.

2. CLAIM AMENDMENTS

Claims 1–11 were pending in the application. Claims 1 and 11 have been amended to clarify the invention. No new matter has been added. Upon entry of the present amendment, claims 1–11 will be pending.

3. THE CLAIMS ARE NOT INDEFINITE

Claim 11 is rejected under 35 U.S.C. § 112, second paragraph, as allegedly indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

Applicants have amended claim 11 to depend from claim 10, to correct for a typographical error. As the Examiner noted, claim 10 provides the proper antecedent basis for claim 11. Applicants believe the amended claim obviates the rejection, and request that the rejection of claim 11 under 35 U.S.C. § 112, second paragraph, be withdrawn.

4. THE CLAIMS ARE NOT ANTICIPATED BY THE CITED REERENCES

Claims 1–11 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by EP 0,634,204 ("EP '204"), United States Patent No. 5,015,268 to Ho ("Ho"), United States Patent Publication No. 2001/0013273 to Kang *et al.* ("Kang 1"), or United States Patent Publication No. 2001/0015334 to Kang *et al.* ("Kang 2"). Applicants respectfully traverse this rejection.

Applicants have amended claim 1 to clarify that Applicants' facilitated transport membrane for separating alkene hydrocarbons from hydrocarbon mixtures is capable of operating under dry operating conditions. Applicants' facilitated transport

membrane comprises a porous supported membrane and a transition metal salt-polymer membrane. The transition metal salt-polymer membrane consists essentially of a transition metal salt and a polymer, where the transition metal salt is physically dispersed within the polymer. In particular, Applicants require that the polymer has no functional group capable of forming a complex with the transition metal salt.

Applicants' Facilitated Transport Membrane is not Anticipated by EP '204

Applicants' facilitated transport membrane is not disclosed or suggested in EP '204, because Applicants' facilitated transport membrane is capable of operating under dry operating conditions. Reference EP '204 discloses a process for the separation under wet conditions of an unsaturated hydrocarbon from a fluid mixture containing other hydrocarbons. Specifically, EP '204 discloses the use of a polymeric membrane together with a complexing agent (*i.e.*, a solution of a transition metal salt in water) for separating alkene hydrocarbons from hydrocarbon mixtures. (See, *e.g.*, EP '204, p. 5, Example 1.) In the first stage of the process, the unsaturated hydrocarbon migrates through a polymer membrane to a carried fluid. In the second stage of the process, the unsaturated hydrocarbon is separated from the carrier fluid and removed. (See, *e.g.*, EP '204, p. 3, lines 10-16.) However, as Applicants have described in the present specification, such a process presents many problems, such as requiring the use of a liquid solvent for separating gas-phase mixtures (*e.g.*, alkene/alkane mixtures), and the use of separated reactors for the complexation and dissociation of an alkene, which can cause solvent loss and lengthen the time needed for the separation process. (See specification, *e.g.*, paragraphs [0009] to [0014]). By contrast, Applicants' facilitated transport membrane is capable of operating under dry operating conditions. Unlike in the active layer disclosed in EP '204 where the metal salt is kept outside the polymer membrane for separating an unsaturated hydrocarbon, Applicants' invention has adopted a transition metal salt/polymer mixture membrane where a transition metal salt is dispersed in the polymer matrix. Applicants' facilitated transport membrane does not require separate reactors or feed of a liquid solvent, such as water, which has to be removed from the separated alkenes. As a result, Applicants' entire process is more efficient in comparison with the process disclosed in EP '204. Applicants submit that EP '204 does not disclose or suggest Applicants' facilitated transport membrane capable of operating under dry operating conditions. Therefore, Applicants' facilitated transport membrane is not anticipated by EP '204.

In view of the foregoing, the rejection of claims 1–11 under 35 U.S.C. §

102(b) as anticipated by EP 0,634,204 should be withdrawn.

Applicants' Facilitated Transport Membrane is not Anticipated by Ho, Kang 1 or Kang 2

Applicants' facilitated transport membrane is not anticipated by Kang 1 or Kang 2, because both references teach away from Applicants' claimed invention. Kang 1 is directed to use of a solid state facilitated transport separation membrane for the separation of alkenes from alkene/alkane mixtures, where the membrane comprises a polymer electrolyte layer consisting of a transition metal salt and a polymer having a functional group capable of forming a complex with the transition metal on a porous supported membrane. Kang 2 is directed to a facilitated transport separation membrane for the separation of alkenes from alkene/alkane mixtures, where the membrane comprises a polymer electrolyte layer consisting of a transition metal salt and a non-volatile, high polarity polymer capable of forming a complex with the transition metal on a porous supported membrane. In particular, it should be noted that both Kang 1 and Kang 2 require formation of a complex between the polymer and the transition metal salt. Kang 1 specifically states in paragraph [0021] that "[t]he polymer used in the invention must easily form a complex with the metal salt." (Emphasis added.) Similarly, Kang 2 specifically states in paragraph [0036] that "[t]he polymer used in the invention must easily form a complex with the transition metal salts." (Emphasis added.) By contrast, Applicants require that the polymer has no functional group capable of forming a complex with a transition metal salt. (See specification, *e.g.*, paragraph [0037].) As an example, Applicants disclose polypropylene as a representative polymer for use in Applicants' invention. (See specification, *e.g.*, paragraph [0037].) By contrast, Kang 2 teaches that polypropylene is unsuitable, because its dielectric constants of only 2.34 is too low to easily form a complex with transition metal salts. (See Kang 2, *e.g.*, Table 3 and paragraph [0039].) Therefore, Applicants' invention is not anticipated by either Kang 1 or Kang 2, because both references teach away from Applicants' claimed invention comprising a polymer that has no functional group capable of forming a complex with a transition metal salt.

Applicants' facilitated transport membrane is also not anticipated by Ho for at least the same reasons that Applicants' claimed invention is not anticipated by either Kang 1 or Kang 2. Ho requires use of a hydrophilic polymer "which is associated with a complexing metal ion or salt." (See Ho, *e.g.*, col. 5, lines 4-6.) Ho discloses that suitable hydrophillic polymers for use to prepare membranes include polyvinyl-alcohol, polyvinylacetate,

polyvinylpyrrolidone and polyacrylamide. (See Ho, *e.g.*, col. 5, lines 7-12.) It should be noted that these suitable hydrophillic polymers listed in Ho are also specifically listed in Kang 2 as polymers that easily form complexes with transition metal salts. (See Kang 2, *e.g.*, paragraph [0039].) Also note that Kang 1 lists hydrophillic polymers for forming the complexes with the metal atoms, such as polyvinylpyrrolidone and polyacrylamide. (See Kang 1, *e.g.*, paragraph [0022].) For example, Ho, Kang 1 and Kang 2 all employ a membrane comprising hydrophilic polymers such as a poly(2-ethyl-2-oxazole) (POZ) or a poly(2-ethyl-2-oxazoline) (PEO). Therefore, Ho's requirement of a hydrophillic polymer is cumulative to the requirements of both Kang 1 and Kang 2 of polymers that easily form complexes with transition metal salts.

Applicants' claimed invention requires a polymer which has no functional group capable of forming a complex with a transition metal salt, such as a polydimethyl siloxane (PDMS). Applicants have discovered that a membrane comprising such a polymer and a transition metal salt, where the transition metal salt is physically dispersed in the polymer matrix, has superior long-term operational performance characteristics over the types of membranes disclosed in Ho, Kang 1, and Kang 2, comprising a hydrophilic polymer. Applicants' membrane eliminates the problems associated with the polymers disclosed in Ho, Kang 1, and Kang 2, such as reduction of a transition metal ion to a transition metal. (See specification, *e.g.*, paragraphs [0041] and [0065].) As Applicants have shown in Table 8 on page 21 of the specification, the permeability and selectivity of the hydrophilic polymer/transition metal salt membrane (*e.g.*, POZ/$AgBF_4$ membrane) continuously decreases with time. By contrast, the performance of the PMDS/transition metal salt membrane (*i.e.*, PDMS/$AgBF_4$ membrane) remained basically stable under long-term operation of nearly 150 hrs. Therefore, Applicants' claimed invention is not anticipated by any of Ho, Kang 1 or Kang 2, because the references all teach away from Applicants' claimed invention.

In view of the foregoing, the rejection of claims 1–11 under 35 U.S.C. § 102(b) as anticipated by Ho, Kang 1 or Kang 2 should be withdrawn.

CONCLUSION

Applicants respectfully request that the foregoing amendments and remarks be made of record in the file of the above-identified application. Applicants believe that each ground for rejection has been successfully overcome or obviated, and that all pending claims are in condition for allowance. Withdrawal of the Examiner's rejections, and allowance of the application, are respectfully requested. If any issues remain in connection herewith, the Examiner is respectfully invited to telephone the undersigned to discuss the same.

No fee is believed due in connection with this response. In the event that a fee is required, please charge any such fees to Jones Day Deposit Account No. 50-3013.

Respectfully submitted,

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